SOCIAL SCIENCES

Focal random selection closes the gender gap in competitiveness

Joël Berger[1], Margit Osterloh[2,3], Katja Rost[4]*

Gender differences in choosing to enter competitions are an important cause of the leaky pipeline for women in leadership roles and represent a considerable waste of human resources. We used an incentivized laboratory experiment to evaluate whether the introduction of random elements alters the gender gap in competitiveness. We found that focal random selection from a preselected pool removes the difference in competitiveness between men and women and does not dilute the qualifications of the entrants. The percentage of women who took part in competitions was nearly triple, and that of high-ability women double, with focal random selection compared to selection in pure performance competitions. In contrast, the behavior of men remained largely unchanged. Focal random selection closes the gender gap in competitiveness and can substantially enlarge the pool of high-performing women who apply for top jobs.

INTRODUCTION

Numerous laboratory and field experiments have demonstrated that women opt out of competition more than men, even when they are equally or better qualified (*1*–*7*). When women shy away from competition, they have poor chances of increasing their share of leadership positions at the top. Moreover, if only a few high-ability women apply for top positions, valuable human resources are wasted; it remains unsure whether the brightest and best are promoted.

Attempts to overcome the gender gap in competitiveness take two major avenues: Change the women or change the institutions (*8*). The first avenue involves attempts to make women more competitive, for instance, by recommending that they “lean in” (*9*), that their self-consciousness is strengthened by priming (*6*, *7*), and that they are given feedback (*10*). The second avenue aims to make institutions more gender neutral so that high-performing women are encouraged to “play their own game” instead of having to enter a competition inconsistent with their prevailing preferences. It has been shown that institutional approaches such as soft quotas and single-sex competitions significantly reduce the gender gap in competition entry without diluting the quality of the resulting entrants (*4*, *11*, *12*). However, those approaches may cause unwarranted side effects (*13*). We therefore suggest and examine a previously unidentified institutional approach: focal random selection. From a preselected pool of the most highly qualified candidates, a lottery decides who wins promotion. We show in a laboratory experiment that under these conditions, the gender gap in competition entry disappears.

Focal random selection has a long yet little-known history. It was applied in ancient Athens, in the Golden Age of Venice, and in other medieval cities such as Florence and Bern (*14*). At the University of Basel during the 18th century, vacant professorships were filled by lot from the three most qualified candidates (*15*, *16*). The main reasons for using lotteries in former days were to avoid corruption and strong conflicts between influential dynasties (*15*). Today, focal random selection is used for allocating grants (*17*) and has been suggested for the selection of papers for publication (*18*) to overcome problems arising from the peer review process. It has been tested as a means of overcoming hubris in group leaders (*14*). Through randomly selected citizens’ forums, it has been applied as a remedy against social selectivity in political decision-making (*19*). To our knowledge, it has never been applied to overcome the gender gap in competitiveness.

We propose that focal random selection reduces the gender gap in competitiveness by encouraging women to enter competitions. First, lotteries reduce competition and therefore tackle women’s aversion to competing. This aversion has been shown to persist after controlling for risk aversion, confidence, and feedback aversion (*2*). Second, women exhibit greater risk aversion than men (*20*). The impact of luck helps them to avoid the psychological costs of risky decision-making. Third, people who underestimate their abilities—which is on average the case for women (*21*)—might be less anxious to apply for a shortlist with focal random selection because they need not think themselves superior. Fourth, high-ability women, in particular, are more averse to, and more strongly influenced by, negative feedback than are men. They are more likely to give up after a setback. This has been shown in both laboratory experiments (*2*) and the field (*22*). If the winner is determined mainly by luck, high-ability women’s greater anxiety concerning negative feedback is reduced. Fifth, discrimination and the fear of being discriminated against are excluded (*23*). Last, while men are valued for their competitiveness, for example, for higher job status or higher salaries than women, females who win competitions in gender-mixed settings are in danger of being considered unlikable (*24*). They deviate from social identity norms, which leads to psychological costs (*25*) such as annoyance and other negative feelings and a high rate of divorces (*26*). Numerous studies have confirmed that women anticipate these costs (*27*–*29*). Random selection safeguards male losers from losing face, and female winners do not deviate from identity norms and therefore are able to avoid psychological costs.

In summary, focal random selection can enlarge the pool of suitable candidates for top positions with the many high-ability women who were previously discouraged from taking part in competitions. Instead of forcing women into strong competitions that they do not appreciate, and in which they are disadvantaged, selection mechanisms are changed in a way that fits better into prevailing female

[1]Institute of Sociology, University of Bern, Fabrikstrasse 8, 3020 Bern, Switzerland. [2]CREMA—Center for Research in Economics, Management and the Arts, Südstrasse 11, 8008 Zurich, Switzerland. [3]CREW—Center for Research in Economics and Well-Being, University of Basel, Peter Merian-Weg 6, 4002 Basel, Switzerland. [4]Institute of Sociology, University of Zurich, Andreasstrasse 15, 8050 Zurich, Switzerland.
*Corresponding author. Email: katja.rost@uzh.ch

preferences. This is the main advantage of focal random selection. However, pure random selection alone has two main disadvantages. First, it does not distinguish between able and less able candidates. This disadvantage is mitigated by a thoughtful preselection of the most qualified candidates. The better the preselection works, the smaller is the difference between final candidates (*30*). Second, a taste for competition might be a desirable characteristic for leadership positions. However, strong competition not only discourages women from applying for top jobs but may also trigger hubris in people, which can be mitigated by focal random selection (*14*). The intensity of competition might be varied, for instance, by adjusting the number of candidates who compete for a position or by the incentives provided for the winners (*31*). Therefore, the degree of competitiveness in the selection procedure must achieve a difficult balance between the contradictory characteristics of candidates.

METHODS

Table 1 summarizes the design of an incentivized laboratory experiment conducted at the Decision Science Laboratory at ETH Zürich in November 2019 using zTree (*32*). In total, 210 male and 210 female students were randomly selected from a pool of candidates.

Table 1. Summary of the experimental design. We used the addition task test (*2*, *6*) to study gender preferences for competition. It involves computing the sum of five randomly selected two-digit numbers and performing as many calculations as possible within 3 min. The participants had to solve the test in stages 1, 2, and 3. Swiss Francs (CHF) were expressed in money points (MPs); 1 MP = 0.5 CHF.

Stage 1:			
Payment scheme A	1 MP for each correct answer.		
	Performance treatment	**Pure random treatment**	**Focal random treatment**
	Groups of three men and three women.		
	Performance is evaluated in comparison to the other group members.		
	Winner, 10 MP per correct calculation; other members, no payment.		
Stage 2:			
Payment scheme B	Winner = group member with the most correct answers.	Winner = drawn by lot.	Winner = drawn by lot from the three group members with the most correct answers.
Stage 3:	Choose between payment scheme A (as in stage 1) or payment scheme B (as in stage 2).		
Payment scheme A or B	Performance under scheme B is evaluated against the other group members' performance in stage 2. Winner, 6 MP per correct calculation; other members, no payment.		
Number of Participants	138	144	138
Men	69	72	69
Women	69	72	69

On average, they gained CHF 33 (USD 34) for 1 hour. We followed the procedure described by Balafoutas *et al.* (*6*), who investigated how the gender gap in competitiveness can be closed through priming (see the Supplementary Materials for details). Participants were randomly assigned to groups of three men and three women, and the groups were, in turn, assigned to one of three treatment conditions. Each group in each condition went through three stages. The experimental task in each stage was to add up as many two-digit numbers as possible within 3 min.

In stage 1, each participant received 1 MP (money point; 1 MP = CHF 0.5) for each correct calculation in a piece rate scheme, here called payment scheme A. In stage 2, the winner received 10 MP for each correct calculation and the other team members received nothing in a tournament or competition scheme; this is here called payment scheme B. Stage 2 included three treatments. In the performance treatment, the member who solved the highest number of calculations was selected as the winner in a pure tournament. In the pure random treatment, the winner was chosen by lot. In the focal random treatment, the winner was drawn by lot from the three participants who had solved the highest number of calculations correctly. In stage 3, the participants had to choose between payment scheme A or payment scheme B before solving the calculations. If participants in the performance selection treatment and the focal random treatment chose payment scheme B in stage 3, their performances at this stage were compared to their group's other members' performances in stage 2, thus avoiding the possibility that expectations about other members' entry decisions might affect participants' choices. Those performing equal or better than the fourth-listed group member in stage 2 were shortlisted in stage 3. The winner was then chosen at random from the shortlist; every member on the shortlist had a probability of one in three of winning. The winner's payoff in stage 3 was 6 MP for each correct calculation. We then ran an investment task to measure risk preferences (*33*), and the participants took questionnaires on gender stereotypes (*34*, *35*) and basic demographic information.

RESULTS

Figure 1 shows the relative frequency with which participants in each treatment chose to compete in stage 3 and corresponding 95% confidence intervals (for descriptive statistics, see also table S1). In the performance treatment, men competed around three times as often as women [49.28% versus 14.49%; $\chi^2(1) = 22.33$, $P = 0.000$]. However, in the pure random and focal random treatments, this gender gap becomes insignificant. In the pure random treatment, men's entry rates were slightly lower and women's entry rates were markedly higher than in the performance treatment [31.94% versus 44.44%; $\chi^2(1) = 2.42$, $P = 0.123$]. In the focal random treatment, men did not change their entry rates, but women markedly increased their entry rates relative to the performance treatment [47.83% versus 40.58%; $\chi^2(1) = 0.74$, $P = 0.391$]. This finding strongly supports our proposal that the gender gap in competition can be overcome by focal random selection. The pool of women who took part in competitions was three times higher in the focal random treatment than in the performance treatment: 40.58 and 14.49%, respectively. Findings are highly robust when we control for age, semester, and performance (see the Supplementary Materials: figs. S1 and S2 and tables S1 to S5). Not only is the proportion of female competitors higher under focal random selection than under performance selection;

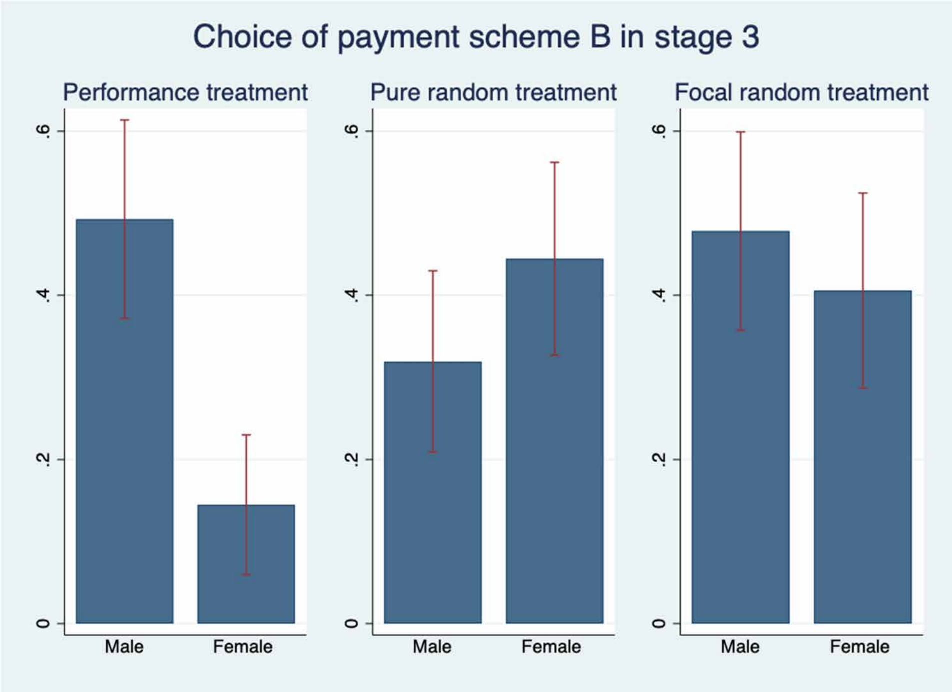

Fig. 1. Entry into competition of men and women in the treatments ($n = 420$). This figure shows the frequency with which men (=210) and women (=210) choose to compete in stage 3 in the treatments, including 95% confidence intervals. In the performance treatment, only 14.49% of women but 49.28% of men enter tournaments [$\chi^2(1) = 22.33$, $P = 0.000$], confirming that women shy away from competition. In the random treatment, only 31.94% of men but 44.44% of women enter tournaments [$\chi^2(1) = 2.42$, $P = 0.123$]. In the focal random treatment, 40.58% of women and 47.83% of men enter tournaments [$\chi^2(1) = 0.74$, $P = 0.391$], confirming that women do not shy away from competition under these conditions.

under this procedure, the proportion of women on the shortlist for winner selection is 45% (25 of 55), which then translates to 27.78% female winners (5 of 18), compared to 5.26% (1 of 19) under performance selection and 57.14% (12 of 21) under random selection (see table S6 for more information).

Do focal random selections offer incentives to compete for men and women who perform above average? We use average stage 2 performance across treatments (6.56 correctly solved problems) and average stage 3 performance across treatments (6.83 correctly solved) as reference points with which to identify over- and under-entry in stage 2 and stage 3, respectively. Above-average participants should choose scheme B (tournament or competition scheme), and below-average participants should choose scheme A (piece rate scheme). Opposing decisions are defined as under-entry and over-entry, respectively. In the performance treatment, the under-entry of men performing above average is half as great as the under-entry of women performing above average [43.9% versus 76. 9%; $\chi^2(1) = 7.07$, $P = 0.008$], confirming former studies (*2*). In the focal random treatment, the under-entry of men performing above average is higher, while the under-entry of women performing above average is lower, thereby closing the gender gap in underinvestment [56.1% versus 60.0%; $\chi^2(1) = 0.10$, $P = 0.756$; see Table 2]. These results remain robust when using stage 3 performance [performance selection: 37.2% underinvestment among men versus 75.8% among women, $\chi^2(1) = 11.17$, $P = 0.001$; focal random selection: 55.0% men versus 61.3% women, $\chi^2(1) = 0.283$, $P = 0.595$] and in a robustness check making use of treatment-specific average performance instead of overall average performance (table S7). These findings are mirrored in the earnings in stage 3: men and women who perform below average earn significantly less than those performing above average, in both the performance (5.4 MP/5.4 MP versus 20.5 MP/7.2 MP) and focal random treatments (7.4 MP/5.3 MP versus 15.6 MP/11.1 MP; see Fig. 2 and table S8). However, the focal random treatment produces a larger gap between low- and high-performing women from 1:1.3 to 1:2.1 and a smaller one for men from 1:3.8 to 1:2.1. Focal random selection thus closes the gender pay gap: It improves the earnings of high-performing women to nearly the same extent as it reduces those of high-performing men.

Figures 3 to 6 demonstrate that in the performance treatment, women shy away from competition because of performance differences, risk aversion, underconfidence, and identity costs, supporting former research (*2*, *21*, *22*, *36*–*38*). Figure 3A shows that in the performance treatment, high-performing men competed three times as often as high-performing women [63% versus 20%; $\chi^2(1) = 13.11$, $P = 0.000$]. This gender gap closes in the pure random and focal random treatments in Fig. 3 (B and C): Relative to the performance treatment, the proportion of high-performing men entering competition was half, whereas the proportion of high-performing women was nearly triple [pure random: 34% versus 53%; $\chi^2(1) = 1.58$, $P = 0.208$; focal random: 38% versus 50%; $\chi^2(1) = 0.73$, $P = 0.394$]. It shows that the pool of high-ability women who take part in competitions is nearly double under focal random selection: 38%, against 20% in the performance treatment. Figure 4A demonstrates that the performance treatment favors risk-seeking men: They competed nearly four times as often as risk-seeking women [62% versus 17%; $\chi^2(1) =16.82$, $P = 0.000$]. Conversely, Fig. 4B shows that the pure

Table 2. Over- and under-entry in stage 3. We use average stage 2 performance across treatments (6.56 correctly solved problems) and average stage 3 performance across treatments (6.83 correctly solved) as reference points for over- and under-entry in stages 2 and 3, respectively. Above-average participants should choose scheme B, and below-average participants should choose scheme A. Opposing decisions are defined as under-entry and over-entry, respectively. Percentages are in parentheses.

	Performance treatment		Random treatment		Focal random treatment	
	Men	Women	Men	Women	Men	Women
Calculations based on stage 2 performance						
Under-entry						
Number who should enter	41	26	36	28	41	25
Of those, how many do not enter	18 (43.9)	20 (76.9)	25 (69.4)	14 (50.0)	23 (56.1)	15 (60.0)
Over-entry						
Number who should not enter	28	43	36	44	28	44
Of those, how many do enter	11 (39.3)	4 (9.3)	12 (33.3)	18 (40.9)	15 (53.6)	18 (40.9)
Calculations based on stage 3 performance						
Under-entry						
Number who should enter	43	33	46	29	40	31
Of those, how many do not enter	16 (37.2)	25 (75.8)	34 (73.9)	16 (55.2)	22 (55.0)	19 (61.3)
Over-entry						
Number who should not enter	26	36	26	43	29	38
Of those, how many do enter	7 (26.9)	2 (5.6)	11 (42.3)	19 (44.2)	15 (51.7)	16 (42.1)

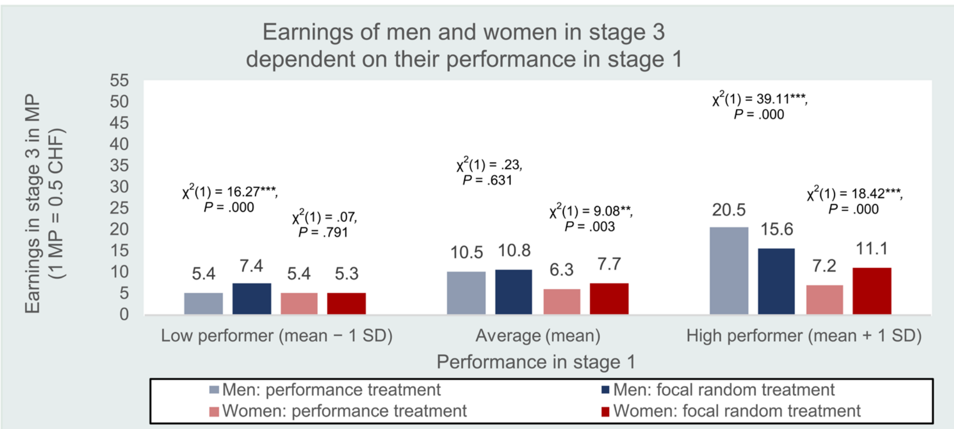

Fig. 2. Earnings of men and women in the performance and focal random treatments ($n = 419$). This figure shows the earnings of men and women in stage 3 for the performance treatment and focal random treatment, which depends on their average performance in stages 1 and 2. Earnings were calculated as marginal effects by controlling for all independent variables (for the regression results, see table S5). According to this, men performing above average lose about 5 MP in the focal random treatment compared to the performance treatment [20.5 versus 15.6, $\chi^2(1) = 51.64$, $P = 0.000$], whereas women performing above average gain about 4 MP [7.2 versus 11.1, $\chi^2(1) = 18.42$, $P = 0.000$], thereby producing lower gender differences in payouts in the focal random treatment. In the focal random treatment, the earnings of men performing above average are still around 50% higher than the earnings of average-performing men, thus offering serious incentives for a competition by performance also for men. ***$P < 0.001$, **$P < 0.01$, *$P < 0.1$

random treatment favors risk-averse women: They chose this alternative nearly four times as often as risk-averse men [men versus women; 12% versus 40%; $\chi^2(1) = 9.19$, $P = 0.002$]. Figure 4C summarizes the results for the focal random treatment. Here, nearly the same proportions of risk-seeking men and women [57% versus 70%; $\chi^2(1) = 1.04$, $P = 0.309$] and of risk-averse men and women [23% versus 24%; $\chi^2(1) = 0.00$, $P = 0.950$] enter competition. Figure 5A shows that overconfident men in the performance treatment

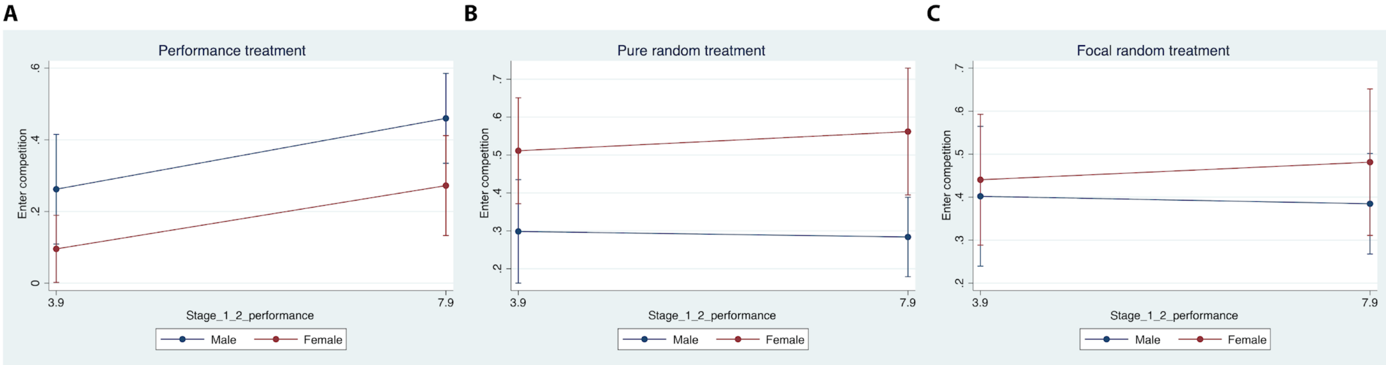

Fig. 3. Mechanisms underlying the gender competition gap: average performance in stages 1 and 2 ($n = 419$). This figure illustrates the marginal effects of the choices of men and women in stage 3 depending on the underlying mechanism (mean ± 1 SD). We controlled for all variables as indicated in table S4, model 2. The independent variable is average performance in stages 1 and 2. (**A**) In the performance treatment, 46% of high-performing men but only 27% of high-performing women enter competition [$\chi^2(1) = 3.78$, $P = 0.052$]. (**B**) In the pure random treatment, 28% of high-performing men and 56% of high-performing women enter payment scheme B [$\chi^2(1) = 7.61$, $P = 0.006$], indicating effects contrary to those of (A). (**C**) In the focal random treatment, 38% of high-performing men and 48% of high-performing women enter competition [$\chi^2(1) = 0.83$, $P = 0.362$], showing that performance has no effect on gender-specific choices in this treatment condition.

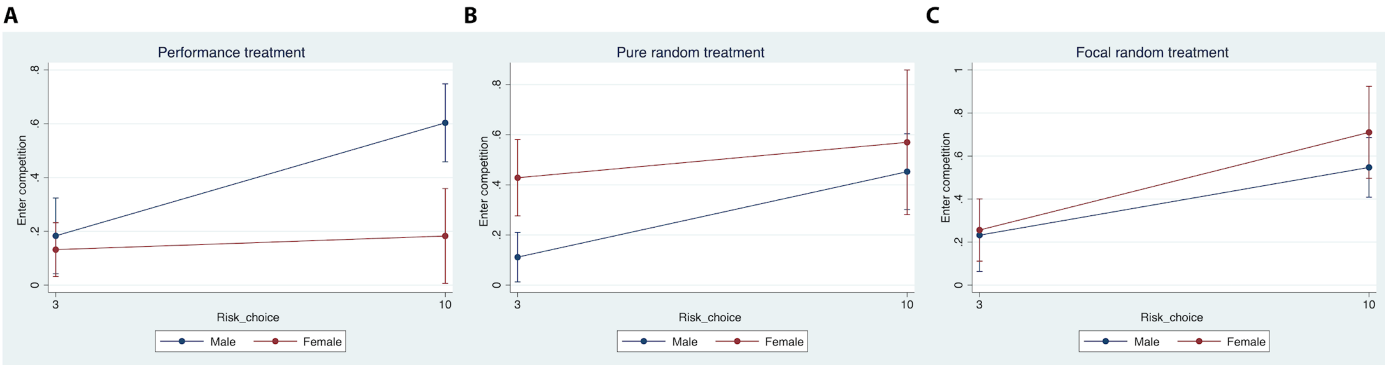

Fig. 4. Mechanisms underlying the gender competition gap: risk aversion after the end of stage 3 ($n = 419$). This figure illustrates the marginal effects of the choices of men and women in stage 3 depending on the underlying mechanism (mean ± 1 SD). We controlled for all variables as indicated in table S4, model 2. The independent variable is risk aversion measured after the end of stage 3 with a simple investment game. Participants received an endowment of 12 MP, which they could invest in a risky asset or keep for themselves. Any amount between 0 and 12 MP could be invested. The investment had a 50% chance of being successful. In the case of success, the invested amount was multiplied by 2.5 and paid back to the participant. If the investment was not successful, the invested amount was lost. MPs not invested were kept by participants. Higher investments in this task thus indicate a greater willingness to take risks. (**A**) In the performance treatment, 60% of risk-seeking men but only 18% of risk-seeking women enter competition [$\chi^2(1) = 12.91$, $P = 0.000$]. (**B**) In the pure random treatment, 45% of risk-seeking men and 57% of risk-seeking women enter payment scheme B [$\chi^2(1) = 0.50$, $P = 0.481$], but only 11% of risk-averse men and 43% of risk-averse women [$\chi^2(1) = 11.69$, $P = 0.001$]. (**C**) In the focal random treatment, 55% of risk-seeking men and 71% of risk-seeking women enter competition [$\chi^2(1) = 1.61$, $P = 0.447$], and 23% of risk-averse men and 26% of risk-averse women [$\chi^2(1) = 0.04$, $P = 0.833$], showing that risk aversion has no effects on gender-specific choices.

competed nearly six times as often as overconfident women [55% versus 10%; $\chi^2(1) = 15.97$, $P = 0.000$]. The gender gap caused by overconfidence is lower in treatments with randomness, as shown in Fig. 5 (B and C): Relative to the performance treatment, the proportion of overconfident men choosing this alternative was nearly half, whereas the proportion of overconfident women was four times [pure random: 26% versus 44%; $\chi^2(1) = 2.22$, $P = 0.136$; focal random: 31% versus 40%; $\chi^2(1) = 0.63$, $P = 0.427$]. Last, Figure 6A illustrates that in the performance condition, men not conforming to typical masculine gender stereotypes competed 17 times as often as women not conforming to typical feminine gender stereotypes [50% versus 3%; $\chi^2(1) = 38.52$, $P = 0.000$]. The gender gap caused by gender stereotypes is completely eliminated in treatments with randomness, as illustrated in Fig. 6 (B and C): Relative to the performance treatment, the proportion of competing women not conforming to gender stereotypes was 10-fold higher, whereas the proportion of competing men not conforming to gender stereotypes was more or less equal [men versus women; pure random: 23% versus 25%; $\chi^2(1) = 0.04$, $P = 0.845$; focal random: 50% versus 35%; $\chi^2(1) = 0.86$, $P = 0.353$].

DISCUSSION

Our findings suggest that the pool of high-performing women who apply for top jobs can be substantially enlarged by the introduction of focal random selection. Consequently, the pipeline for women to leadership positions can be made less leaky without lowering candidates' performance. Moreover, focal random selection closes the gender pay gap among high performers. In addition, differences between men

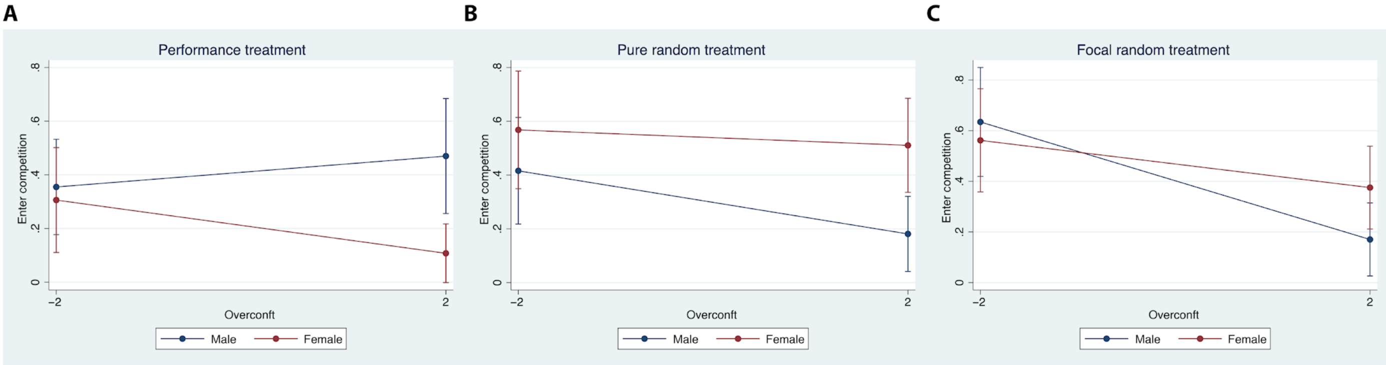

Fig. 5. Mechanisms underlying the gender competition gap: overconfidence in stages 1 and 3 ($n = 419$). This figure illustrates the marginal effects of the choices of men and women in stage 3 depending on the underlying mechanism (mean ± 1 SD). We controlled for all variables as indicated in table S4, model 2. The independent variable is average overconfidence operationalized in stages 1 and 2, as in previous experimental studies (*39*). We included participants' real performance rank in the group in stage 1 or stage 2 and participants' estimated performance rank in the group in stage 1 or stage 2. Overconfidence is defined as the difference between real and estimated performance. Positive numbers indicate overconfidence and negative numbers indicate underconfidence. (**A**) In the performance treatment, 47% of overconfident (overconft) men but only 11% of overconfident women [$\chi^2(1) = 8.62$, $P = 0.003$], and 35% of underconfident men and 30% of underconfident women [$\chi^2(1) = 0.13$, $P = 0.716$] enter competition. (**B**) In the pure random treatment, only 18% of overconfident men but 51% of overconfident women [$\chi^2(1) = 8.10$, $P = 0.004$] and 42% of underconfident men and 57% of underconfident women [$\chi^2(1) = 1.05$, $P = 0.305$] enter payment scheme B. (**C**) In the focal random treatment, 17% of overconfident men and 37% of overconfident women enter competition [$\chi^2(1) = 3.44$, $P = 0.064$], and 64% of underconfident men and 56% of underconfident women [$\chi^2(1) = 0.24$, $P = 0.628$], showing that over- and underconfidence have weaker effects on gender-specific choices than the performance treatment.

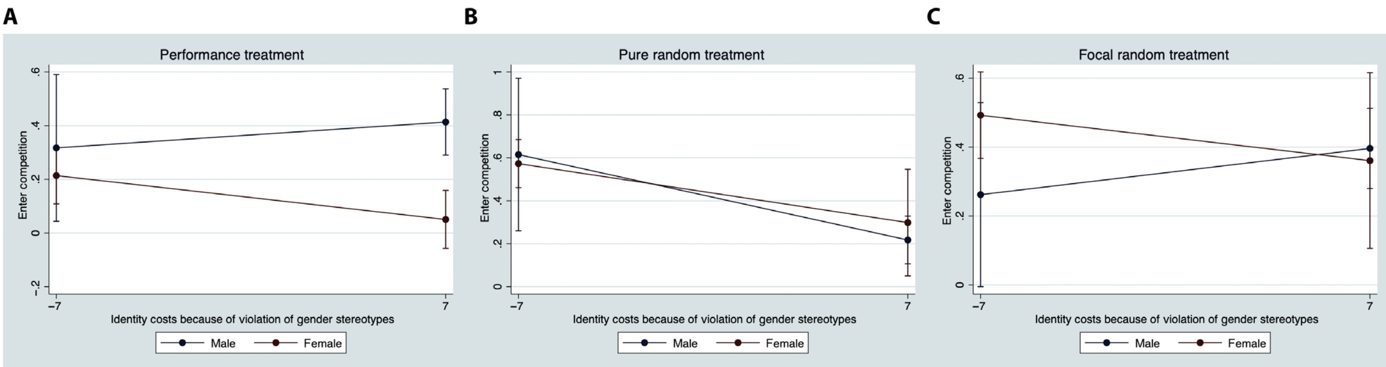

Fig. 6. Mechanisms underlying the gender competition gap: not conforming to gender stereotypes ($n = 419$). This figure illustrates the marginal effects of the choices of men and women in stage 3 depending on the underlying mechanism (mean ± 1 SD). We controlled for all variables as indicated in table S4, model 2. Independent variables are not conforming to gender stereotypes measured with a short version of the Bem Sex Stereotypes Scale (*34*, *35*) including five typical masculine and five typical feminine attributes (*40*). We used nine-point scales to measure whether participants perceive attributes as typically masculine (=1), gender neutral (=5), or typically feminine (=9), and how strongly participants personally meet these attributes (1 = incorrect up to 9 = correct). Violations of gender stereotypes were measured as the multiplication of perceived attributes and met attributes. Women were assigned high negative values if attributes were perceived as typically feminine (=−4) and met by the participant (=9) and strong positive values if attributes are perceived as typically masculine (=4) and met by the participant (=9). For men, the procedure was analogously the opposite. Higher values thus imply higher nonconformations to gender stereotypes. (**A**) In the performance treatment, 41% of men violating gender stereotypes but only 5% of women violating gender stereotypes [$\chi^2(1) = 18.51$, $P = 0.000$] enter competition. (**B**) In the pure random treatment, only 22% of men violating gender stereotypes and 30% of women violating gender stereotypes [$\chi^2(1) = 0.34$, $P = 0.560$] enter payment scheme B. (**C**) In the focal random treatment, 40% of men violating gender stereotypes and 36% of women violating gender stereotypes [$\chi^2(1) = 0.06$, $P = 0.805$] enter competition, showing that gender stereotypes have a much smaller effect on the choices of women in the focal random treatment than in the performance treatment.

and women in entering competition caused by gender stereotypes are completely eliminated by randomness. Our findings, therefore, point to the relevance of gender stereotypes as an underlying mechanism of gender gap in competitiveness. Further research is required to find out which degree of competitiveness should be applied in the focal random selection procedure to achieve adequate characteristics of the selected leader. More research is also needed to study the effects of focal random selection in the field.

SUPPLEMENTARY MATERIALS

Supplementary material for this article is available at http://advances.sciencemag.org/cgi/content/full/6/47/eabb2142/DC1

REFERENCES AND NOTES

1. U. Gneezy, M. Niederle, A. Rustichini, Performance in competitive environments: Gender differences. *Q. J. Econ.* **118**, 1049–1074 (2003).
2. M. Niederle, L. Vesterlund, Do women shy away from competition? Do men compete too much? *Q. J. Econ.* **122**, 1067–1101 (2007).

3. M. Niederle, L. Vesterlund, Explaining the gender gap in math test scores: The role of competition. *J. Econ. Perspect.* **24**, 129–144 (2010).
4. M. Niederle, C. Segal, L. Vesterlund, How costly is diversity? Affirmative action in light of gender differences in competitiveness. *Manage. Sci.* **59**, IV-264 (2013).
5. C. Günther, N. A. Ekinci, C. Schwieren, M. Strobel, Women can't jump?—An experiment on competitive attitudes and stereotype threat. *J. Econ. Behav. Org.* **75**, 395–401 (2010).
6. L. Balafoutas, H. Fornwagner, M. Sutter, Closing the gender gap in competitiveness through priming. *Nat. Commun.* **9**, 4359 (2018).
7. C. B. Cadsby, M. Servátka, F. Song, How competitive are female professionals? A tale of identity conflict. *J. Econ. Behav. Org.* **92**, 284–303 (2013).
8. M. Niederle, A gender agenda: A progress report on competitiveness. *Am. Econ. Rev.* **107**, 115–119 (2017).
9. S. Sandberg, *Lean in-Women, Work and the Will to Lead* (SAGE Publications Sage, 2015).
10. I. Bohnet, *What Works: Gender Equality by Design* (The Belknap Press of Harvard Univ. Press, 2016).
11. L. Balafoutas, M. Sutter, Affirmative action policies promote women and do not harm efficiency in the laboratory. *Science* **335**, 579–582 (2012).
12. M. Sutter, D. Glätzle-Rützler, L. Balafoutas, S. Czermak, Cancelling out early age gender differences in competition: An analysis of policy interventions. *Exp. Econ.* **19**, 412–432 (2016).
13. A. Leibbrandt, L. C. Wang, C. Foo, Gender quotas, competitions, and peer review: Experimental evidence on the backlash against women. *Manage. Sci.* **64**, 3501–3516 (2017).
14. J. Berger, M. Osterloh, K. Rost, T. Ehrmann, How to prevent leadership hubris? Comparing competitive selections, lotteries, and their combination. *Leadersh. Q.* **31**, 101388 (2020).
15. A. Burckhardt, Ueber die Wahlart der Basler Professoren, besonders im 18. Jahrhundert, in *Basler Zeitschrift für Geschichte und Altertumskunde* (1916), vol. 15.
16. K. Rost, M. Döhne, The Wahl zu Dreyen, The use of lotteries in the election of professors at the University of Basel in the 18th century (Zeitschrift für Organisation (ZfO), Leadership by lot, Special Issue, 2020), pp. 14–18.
17. D. Adam, Science funders gamble on grant lotteries. *Nature* **575**, 574–575 (2019).
18. M. Osterloh, B. S. Frey, How to avoid borrowed plumes in academia. *Res. Policy* **49**, 103831 (2020).
19. P. Fournier, H. Van der Kolk, R. K. Carty, A. Blais, J. Rose, *When Citizens Decide: Lessons from Citizen Assemblies on Electoral Reform* (Oxford Univ. Press, 2011).
20. A. Falk, J. Hermle, Relationship of gender differences in preferences to economic development and gender equality. *Science* **362**, eaas9899 (2018).
21. L. Kamas, A. Preston, The importance of being confident; gender, career choice, and willingness to compete. *J. Econ. Behav. Org.* **83**, 82–97 (2012).
22. T. Buser, H. Yuan, Do women give up competing more easily? Evidence from the lab and the Dutch math olympiad. *Am. Econ. J. Appl. Econ.* **11**, 225–252 (2019).
23. M. E. Heilman, Description and prescription: How gender stereotypes prevent women's ascent up the organizational ladder. *J. Soc. Issues* **57**, 657–674 (2001).
24. L. A. Rudman, C. A. Moss-Racusin, J. E. Phelan, S. Nauts, Status incongruity and backlash effects: Defending the gender hierarchy motivates prejudice against female leaders. *J. Exp. Soc. Psychol.* **48**, 165–179 (2012).
25. G. A. Akerlof, R. E. Kranton, Economics and identity. *Q. J. Econ.* **115**, 715–753 (2000).
26. A. Byrne, J. Barling, When she brings home the job status: Wives' job status, status leakage, and marital instability. *Org. Sci.* **28**, 177–192 (2017).
27. M. Bertrand, E. Kamenica, J. Pan, Gender identity and relative income within households. *Q. J. Econ.* **130**, 571–614 (2015).
28. L. Bursztyn, T. Fujiwara, A. Pallais, 'Acting Wife': Marriage market incentives and labor market investments. *Am. Econ. Rev.* **107**, 3288–3319 (2017).
29. J. Syrda, Spousal relative income and male psychological distress. *Pers. Soc. Psychol. Bull.* **46**, 0146167219883611 (2020).
30. A. Oswald, Rational Randomization by Journal editors–a mathematical derivation: A response to Osterloh and Frey's discussion paper on 'Borrowed Plumes'. *Res. Policy* **49**, 103869 (2020).
31. J. Berger, A. Diekmann, The logic of relative frustration: Boudon's competition model and experimental evidence. *Europ. Sociol. Rev.* **31**, 725–737 (2015).
32. U. Fischbacher, z-Tree: Zurich toolbox for ready-made economic experiments. *Exp. Econ.* **10**, 171–178 (2007).
33. U. Gneezy, J. Potters, An experiment on risk taking and evaluation periods. *Q. J. Econ.* **112**, 631–645 (1997).
34. S. J. Troche, T. H. Rammsayer, Eine Revision des deutschsprachigen Bem Sex-Role Inventory. *Klinische Diagnostik und Eval.* **4**, 262–283 (2011).
35. S. L. Bem, Gender schema theory: A cognitive account of sex typing. *Psychol. Rev.* **88**, 354–364 (1981).
36. A. Falk, A. Becker, T. Dohmen, B. Enke, D. Huffman, U. Sunde, Global evidence on economic preferences. *Q. J. Econ.* **133**, 1645–1692 (2018).
37. G. Riener, V. Wagner, Gender differences in willingness to compete and answering multiple-choice questions—The role of age. *Econ. Lett.* **164**, 86–89 (2018).
38. A. Booth, P. Nolen, Choosing to compete: How different are girls and boys? *J. Econ. Behav. Org.* **81**, 542–555 (2012).
39. I. Larkin, S. Leider, Incentive schemes, sorting, and behavioral biases of employees: Experimental evidence. *Am. Econ. J. Microecon.* **4**, 184–214 (2012).
40. M. E. Heilman, C. J. Block, R. F. Martell, Sex stereotypes: Do they influence perceptions of managers? *J. Soc. Behav. Pers.* **10**, 237–252 (1995).
41. K. Kanthak, J. Woon, Women don't run? Election aversion and candidate entry. *Am. J. Polit. Sci.* **59**, 595–612 (2015).

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